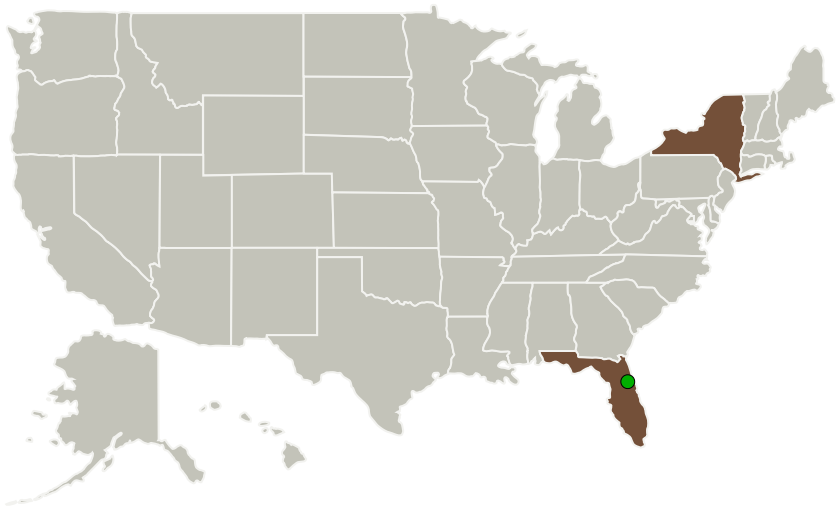
# Parametric Optimization and Prediction Tool for Lunar Surface Systems Excavation Tasks, Phase I

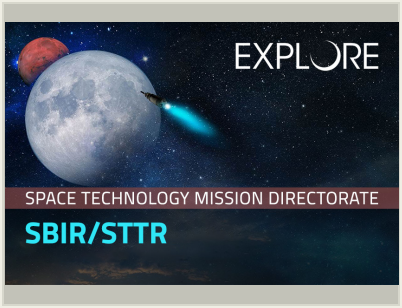
Completed Technology Project (2010 - 2010)

## Project Introduction

Honeybee Robotics proposes to develop a software tool for facilitating lunar excavation system trades in support of selecting an optimal architecture. This will provide engineers with the ability to quickly examine "What if?" scenarios within a trade space by specifying an excavation architecture and receiving data and graphs evaluating that architecture's performance in terms relevant metrics, such as total energy used or total duration. Excavation tasks supporting outpost development and lunar ISRU will require moving hundreds to thousands of tons of regolith per year. Moving this much regolith will require substantial machinery, but transportation costs on the order of $50K to $100K per kilogram to the surface of the Moon make it an economic necessity to make optimal use of lunar excavation equipment. An architecture that saves a few thousand kilograms in equipment will save hundreds of millions in program dollars ⇔ a substantial return on investment. This software aims to be (a) user friendly, (b) relevant to LSS's priorities, and (c) accurate for lunar excavation. Phase 1 will address user-friendliness, relevance, and the theoretical side of accuracy. Phase 2 will expand the tool's relevance to a larger trade space, and attack selected gaps on the empirical side of accuracy. This tool will be based on the very best models and data available, and will benefit from the knowledge and experience of both Dr. Kris Zacny, the Principal Investigator, and Dr. David Carrier, a subcontractor in this effort. Phase 1 will result produce the basic framework for the software, which will be capable of performing analyses for a selected set of excavation scenarios. Phase 2 will then add depth to that framework to address a wide range of excavation tasks and tools, and will involve experimentation to validate and fine tune the software.

## Primary U.S. Work Locations and Key Partners



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| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| Honeybee Robotics, Ltd. | Lead Organization | Industry | Pasadena, California |
| Kennedy Space Center(KSC) | Supporting Organization | NASA Center | Kennedy Space Center, Florida |

| Primary U.S. Work Locations | |
|---|---|
| Florida | New York |

## Project Transitions

**January 2010:** Project Start

**July 2010:** Closed out

**Closeout Summary:** Parametric Optimization and Prediction Tool for Lunar Surf ace Systems Excavation Tasks, Phase I Project Image

**Closeout Documentation:**

- Final Summary Chart Image*(https://techport.nasa.gov/file/140647)*

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Honeybee Robotics, Ltd.

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

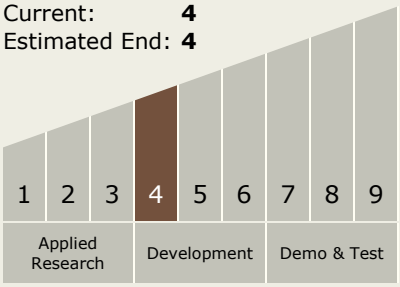
Carlos Torrez

**Principal Investigator:**

Kris Zacny

## Technology Maturity (TRL)

Start: **4**
Current: **4**
Estimated End: **4**



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## Technology Areas

**Primary:**

- TX04 Robotic Systems
  - TX04.3 Manipulation
    - TX04.3.4 Sample Acquisition and Handling

## Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System